ECOLOGICAL ASPECTS OF SHEDDING IN FREE-RANGING HOGNOSE SNAKES (HETERODON PLATIRHINOS)

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Much of our knowledge of the shedding ecology of snakes is based on studies of captive rather than free-living animals (e.g., Banks 1985; Maderson 1985). Whether information from captive snakes reflects what shedding snakes actually do and how they behave in nature requires radiotelemetric studies of free-ranging animals that can be visually checked often enough to yield information on their shedding status (Peterson et al. 1993). For example, Platt (1969) found that although Heterodon nasicus often shed more frequently in captivity, mark-recapture evidence suggested that under natural conditions, adults did not shed more than twice in an activity season.

From April 1992–March 1995, as part of a comparative radiotelemetric study of habitat and movement ecology of resident and translocated snakes, I made 1351 daily observations on eight adult hognose snakes (Heterodon platirhinos) which were resident on an approximate 200 ha study area in central Arkansas. The study area was an open upland oak-hickory forest containing abundant edge habitat and numerous grassy clearings of both natural and man-made origin. After being implanted with either non-temperature sensitive (AVM SM-1) or temperature-sensitive radiotransmitters (Telonics CHP-2P) according to procedures outlined by Reinert (1992), snakes were released into the field, located daily, and visually checked every 3–4 days during the activity season (15 April–15 October). Shedding was detected by the presence of opaque eyes or a shed skin.

The eight snakes were inactive (i.e., did not move between successive location days) on 43% (SD = 12%) of 1351 total locations during the activity season. Inactivity was positively associated with shedding on 24% (SD = 11%) of total locations and thus constituted over half (56%) of inactivity occurrences. Various aspects of shedding were determined by an extended longitudinal analysis of three Heterodon (female no. 1 and males nos. 6 and 8), each of which was monitored in its normal habitat and home range for periods of 546, 702, and 491 consecutive days, respectively, and included two activity seasons. Each of these three snakes shed 3–5 times per year, averaging one shed each 37.0 (SD = 6.5) days, and was inactive for 12.5 (SD = 2.7) days preceding each shed (Table 1). The number of sheds and number of inactive days preceding sheds were similar for a given snake over two years as were the dates of shedding within and among snakes (Table 1). The inactive days preceding shedding were spent under grass or mixtures of grass and herbs or leaves in open or edge habitats (Fig. 1). For each snake, the physical locations of shedding sites were distributed throughout the snake’s large home range.

Figure 1. A melanistic adult female Heterodon platirhinos in the opaque period of ecdysis. To take this photograph, it was necessary to partially dislodge and expose this snake from its typical shedding posture and refugium (i.e., tightly coiled in the base of a clump of grass).
The length of the shedding cycle in free-ranging *H. platirhinos* (37 d) is similar to that in many captive colubrid snakes (e.g., Banks 1985) and to that reported for captive *H. platirhinos* held at constant 25°C (38 d; Smith 1976). Because shedding snakes often are highly secretive and immobile, studies that estimate shedding rates from data collected on the trapping or hand-capturing of only active snakes are likely to underestimate frequency of shedding as apparently did Platt (1969) for *H. nasicus*.

It has been reported that both natural injuries (Appleby 1980; Neill 1949) and surgery (Kauffeld 1969) increase rate of shedding in snakes. It was necessary to surgically replace transmitter batteries during the activity season on five total occasions among *Heterodon* nos. 1, 6, and 8. To test whether surgery affected shedding rates, I compared the intervals between successive sheds that included battery replacement surgery to those intervals between sheds that did not include such surgery. For snake no. 1, three surgeries were necessary. Mean time interval including surgery (\( \bar{x} = 33.3 \pm 8.09 \) [SE] d) was similar to time interval without surgery (\( \bar{x} = 35.4 \pm 4.09 \) d; \( t = 0.26, P > 0.80, df = 6 \)). For snakes 6 and 8, one replacement surgery each was necessary; the respective times including surgery (36 and 37 d) did not differ from times without surgery (\( \bar{x} = 43.7 \pm 9.82 \) and 33.3 ± 4.02 d) (no. 6, \( t = 0.45, P > 0.50, df = 2 \); no. 8, \( t = -0.38, P > 0.50, df = 5 \)). In the lizard *Gekko*, surgery increases shedding rate only if it occurs soon after the previous shed (Maderson 1985).

Captive snakes often demonstrate a strong thermophilic response immediately prior to shedding. Although this behavior is predicted to occur in free-ranging snakes (Peterson et al. 1993), it could be statistically demonstrated in only one of three *H. platirhinos*. A thermophilic response may result in snakes selecting, in comparison to habitats.

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**Table 1.** Dates of shedding, time (\( \bar{x} \pm 1 \text{ SD} \)) between sheds, and time (\( \bar{x} \pm 1 \text{ SD} \)) spent inactive preceding shedding in two consecutive years for three *Heterodon platirhinos*. The unusually long mean time between sheds for no. 6 in 1993 was affected by a 68 d aestivation period from 7 July–12 September in which shedding did not occur. The two dates with question marks indicate probable sheds based on behavior (long period of inactivity followed by a burst of activity), but not confirmed visually by the presence of eye opaqueness or a skin slough.

<table>
<thead>
<tr>
<th>Snake no.</th>
<th>Year</th>
<th>No. days obs.</th>
<th>Dates of shedding for shed no.</th>
<th>No. days between sheds</th>
<th>No. days inactive preceding shedding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>1992</td>
<td>265</td>
<td>-</td>
<td>5/16</td>
<td>7/05</td>
</tr>
<tr>
<td></td>
<td>1993</td>
<td>281</td>
<td>-</td>
<td>5/05</td>
<td>6/20</td>
</tr>
<tr>
<td>6</td>
<td>1993</td>
<td>254</td>
<td>-</td>
<td>5/24</td>
<td>6/30</td>
</tr>
<tr>
<td></td>
<td>1994</td>
<td>365</td>
<td>-</td>
<td>5/16</td>
<td>6/18</td>
</tr>
<tr>
<td>8</td>
<td>1993</td>
<td>253</td>
<td>-</td>
<td>5/26</td>
<td>6/18</td>
</tr>
</tbody>
</table>
Table 2. Percent of daily locations in grassy microhabitats and body temperatures ($\bar{x} \pm 1$ $SE$, $n$) of inactive
shedding and inactive non-shedding *Heterodon platirhinos* during the activity season (15 April–15
October). Results of paired-samples t-tests on body temperatures are shown. In these tests, body tempera-
tures from shedding periods were paired with those from temporally adjacent non-shedding periods for each
individual snake.

<table>
<thead>
<tr>
<th>Snake no.</th>
<th>Grassy loc. (%)</th>
<th>Body temperature ($^\circ$C)</th>
<th>t</th>
<th>f</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>shed</td>
<td>non-shed</td>
<td>shed</td>
<td>non-shed</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>81.6</td>
<td>72.5</td>
<td>28.3 ± 0.46 (76)</td>
<td>26.4 ± 0.45 (131)</td>
<td>-2.62</td>
</tr>
<tr>
<td>6</td>
<td>96.8</td>
<td>82.7</td>
<td>28.8 ± 0.33 (57)</td>
<td>28.6 ± 0.35 (127)</td>
<td>0.29</td>
</tr>
<tr>
<td>8</td>
<td>86.2</td>
<td>79.2</td>
<td>24.1 ± 0.82 (26)</td>
<td>23.5 ± 0.42 (72)</td>
<td>0.50</td>
</tr>
</tbody>
</table>

used between shedding periods, more thermally
favorable open habitats when shedding (Peterson
et al. 1993; Reintert 1993). However, many snakes
also seek cover when shedding and this behavior
may mask a thermophilic response if the cover is
located in the same habitat where the snake is
inactive when not shedding. For example, prior to
shedding, *H. platirhinos* seek cover in the same
micro- and macrohabitats used when they are
inactive and not shedding (i.e., coiled under grass
clumps in open or edge habitats; Platt 1969;
Plummer and Mills, unpubl.), although they do so
at a higher frequency (Table 2; 88.2% vs. 78.1%;
paired $t = 4.78$, $P < 0.05$, $df = 2$). Thus, due to the
common microhabitats used, differences in body
temperature between quiescent shedding and non-
shedding *H. platirhinos* would not, a priori, nec-es-
arily be expected to differ. Active *H. platirhino-

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